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Patentanmeldung Nr. Patent application No. Demande de brevet n°

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PRIORITY DOCUMENT

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Transmission of a first and second digital information signal via a transmission medium.

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The invention relates to a transmitter for transmitting a first and second digital information signal via a transmission medium, said first digital information signal comprising first frames having at least a first synchronization signal and a data portion stored in them, the transmitter comprising:

- input means for receiving the first and second digital information signal;
- processing means for processing the second digital information signal into subsequent second frames, said second frames comprising blocks of information of the second digital information signal;
- signal combination means for inserting a second synchronisation signal and at least the data portion of a first frame into a second frame of the second digital information signal so as to obtain a composite frame;
- output means for supplying the composite frames to an output terminal so as to obtain a composite signal to be transmitted.

The invention further relates to a receiver for receiving a composite signal from a transmission medium and generating a first and a second digital information signal, to a record carrier obtained with the transmitter, when in the form of an apparatus for recording information on a record carrier, and to a transmission method.

Transmitters and receivers defined above are commonly known in the form of transmitters for transmitting an MPEG encode signal. Transmission systems usually use multiple layers. Synchronisation becomes possible only by the use of sync patterns in these layers. However, these sync patterns in a system having multiple sync patterns reduces the transmission efficiency. For example in DVD-Video sync patterns are used in both the system stream layers as well as in the elementary stream layers. Only the sync pattern in the highest system layer is used for synchronisation on the system stream. The sync patterns in the elementry streams are used for synchronization during decoding of said elementry stream. Further, DAB uses sync patterns in both the system stream layer as well as in the elementary stream layer. However a decoder uses only one of both.

The invention aims at providing transmitters and receiver having an more efficient method of transmitting and receiving a first and a second digital information signal, whereby said first digital information signal comprises first frames having at least a second synchronization portion.

The transmitter in accordance with the invention is characterized in that signal combination means are adapted to strip the first synchronization signal from said first frames prior to inserting at least the data portion of the first frames into the second frames.

The receiver in accordance with the invention is characterized in that the receiver further comprises;

- synchronization signal generator means for generating a first synchronization signal;
- signal combination means for combining the first synchronization signal and the at least the data portion of the first digital information signal so as to obtain a first frame of the first digital information signal;
- second output means for subsequently supplying the first frames of the first digital information signal to a first output terminal so as to obtain the first digital information signal.

The invention is based on the following recognition. In for example a buried data channel in a PCM signal any other information signal may be stored. To be able to retrieve the information signal from said buried data channel the buried data channel comprises frames whereby each frame has a synchronization signal. After detecting said synchronization signal, a frame from the buried data channel can be retrieved from the PCM signal. If the information signal stored in the buried data channel is an encoded signal comprising a sequence of frames each having a synchronization signal, for example an MPEG encode signal, said synchronization signal has to be retrieved in a receiver to be able to decode said sequence of frames. However, if each frame in the buried data channel comprises only one frame of the encoded signal, said synchronization signal in a frame of the encoded signal needs not to be transmitted, there said synchronization signal can be generated in the receiver each time a frame in the buried data channel is retrieved. Thus in a transmitter, prior to inserting a frame of the encoded signal into the buried data channel the synchronization signal is striped from said frame. In a receiver the synchronization signal is generated and combined with the data retreived from a frame of the buried data channel so as to obtain a frame of the encoded signal. By doing this the data capacity needed to transmit an additional signal comprising a sequence of frames is reduced. This reduction may be used to use less capacity in the PCM signal for the buried data channel, resulting in a higher quality PCM signal. On

the other hand, the extra data capacity in the buried data channel, obtained by removing the synchronization signal may be used for transmitting a less compressed data signal being normally a better representation of the data signal.

These and other objects of the invention will become apparent from and elucidated further with reference to the embodiments described in the following figure description in which

figure 1 shows a Buried data frame-structure with header,

figure 2 shows the de-randomization circuit,

figure 3:shows The bits in the buried_data_frame need to be inserted into the de-randomization circuit in a specific order,

figure 4 shows a CRC-check diagram,

figure 5 shows A frame of 1152 stereo PCM samples corresponds to 192 F3 frames,

figure 6 shows a Buried data frame structure without header,

figure 7 shows the distribution of Encrypted MPEG2 audio data the buried data channel and the physical channel.

1. INTRODUCTION

In the CD Surround system the coded audio is transported over a burried data channel. This burried data channel is composed of the least significant bits of the PCM samples on a normal CDDA (Compact Disc Digital Audio). This document describes the format of this burried data channel. With this document the way of extracting the coded audio from a CD Surround disc is completely defined.

2. DETAILED PROPOSAL

The main characteristics of a format in accordance with the invention are:

1) The use of PCM frames, each consisting of 9 PCM subframes.

2) The burried data is inserted in the PCM L and R channel on a sample by sample interleaving basis.

3) Each PCM frame starts with a sync pattern in the two least significant bits of its first 6 L+R PCM samples.

4) The burried data bits extracted after the sync pattern are randomized, and thus have to be derandomized before they can be interpreted.

5) The burried data starts with a header, which contains the bit allocation of the 9 subframes. This bit allocation defines the PCM bits belonging to the burried data channel.

6) Each burried data frame ends with a CRC-16 word for error detection.

7) A IEC-61937 coded audio frame can be constructed from the burried data.

More in detail:

ad 1) Frame length

A PCM frame consists of 9 subframes of 128 PCM samples each. Thus the PCM frame length matches exactly the MPEG-2 Audio Layer II frame length.

ad 2) Extraction order

For each of the 9 subframes a bit allocation will be transmitted for both the L and R channel. This bit allocation defines the number of least significant bits that are used by the burried data channel. In alternating order this number of bits is read from the L and R PCM channel. The decoding of the first eight L+R PCM samples of the first subframe of each frame deviate from this procedure. For these samples first the two least significant bits are extracted from all eight samples and only thereafter the remaining burried data bits are extracted.

ad 3) PCM Sync

As described above, the first six PCM samples of a PCM frame contain the first 24 bits of a burried data frame, being a sync pattern. These 24 bits should contain the code: 0xF87E1F (1111 1000 0111 1110 0001 1111).

ad 4) Derandomization

The burried data bits extracted after the sync pattern have to be derandomized according to: out = z[16] ^ z[14] ^ z[3] ^ z[1] ^ z[0], where "^" is the logical exclusive-or operator and z[n] is the bit extracted n bits back. At the start of a new frame the state z has to be initialized with all one's.

ad 5) Burried data header

The first 56 burried data bits after the sync pattern contain a header with the bit allocation of the 9 L+R subframes. The first 6 of these 56 bits contain the bit allocation of the first subframe, and hence defines the additional number of bits that have to be extracted from the first 8 PCM samples of the frame. The bit allocation is coded in three bits for each

channel. The three bit code word is incremented with two to get the actual bit allocation. The header consists of 9 times alternating the bit allocation for the left and right PCM subframe plus two spare bits. As the minimum burried data channel capacity equals two bits per PCM sample per channel, this means that after decoding at most 20 PCM samples the complete header information is available (24 bits sync word plus 56 bits header, divided by 4).

ad 6) CRC-16 protection
The last 16 bits of the burried data contain a CRC-16 word for error detection purposes. Each derandomized burried data bit, except for the last 16, is fed through a LFSR (Linear Feedback Shift Register) with polynomial 0x8005. The final state of the LFSR has to be compared with the burried data CRC-16 word. If these two words are not the same, a transmission error has occured.

ad 7) IEC-61937 formatting
As the first 16 bits of an MPEG Audio frame are unique for the CD Surround application (0xFFFC, 12 bit sync + ID=mpeg-1 + Layer=II + protection=used), they are not transmitted but have to be placed before the extracted and decoded buried data. Furtheremore a preamble consisting of two sync words, an identification word and a payload length word has to placed before the MPEG Audio frame and finally the IEC frame has to be padded with zeros.

It can be notes that the number of bits in a burried data frame be always a multiple of eight, the derandomization can be done very efficiently per eight bits. Also the CRC-16 calculation can make use of this fact. Further, in the described format two bits are reserved in the burried header. These bits may be use for a possible future extension with a phisycal channel and/or copy protection mode.

In accordance with the invention only one sync pattern is transmitted and the other sync patterns are regenerated in the receiver.

Embodiment

The embodiment is described in an appendix. This appendix describes the transmission format of the CD Surround system. The CD Surround system uses noise shaping and dithering to transmit extra audio content within the 16-bit audio PCM data on a normal Audio CD. This extra audio content is compressed according to the MPEG Audio standard. As the first 16 bits of a MPEG Audio frame are unique for the CD Surround application they are

not transmitted. In a CD Surround decoder these 16 bits are placed in front of the bits extracted from the PCM data.

Symbols and abbreviations

||	Logical OR
&&	Logical AND
LML	Limited Multi Level

Introduction

Syntax

Syntax	#bits	format	Value
data_frame() {			
if (anchor==1) {			
buried_data_header()			
buried_data_frame()			
} else {			
physical_data_header()			
physical_data_frame()			
if (content_descriptor==1) {			
buried_data_frame()			
}			
}			

Syntax	#bits	format	Value
buried_data_header() {			
syncword	16	BsMsbf	0xAA95
reserved	2	UiMsbf	
track_nbr	7	Uint7	
buried_data_frame_key_bit	1	BsMsbf	
if (buried_data_frame_key_bit==1) {			
buried_data_frame_key	128	Uint64	
}			

```
}

                                            #bits     format Value
physical_data_header() {
 syncword                                   16        BsMsbf     0xAA95
 content_descriptor                         1         UiMsbf
 reserved                                   1         UiMsbf
 track_nbr                                  7         Uint7
 physical_data_frame_key_bit                1         BsMsbf
 if (physical_data_frame_key_bit==1) {
  physical_data_frame_key                   128       Uint64
 }
}
                                            #bits     format Value
buried_data_frame() {
B=0;
 for (sub_frame=0; sub_frame<3; sub_frame++)
   alloc[0][sub_frame]                      3         Uint3
   alloc[1][sub_frame]                      3         Uint3
   B+=(alloc[0][sub_frame]+alloc[1][sub_frame])*384
 }
 crc4_check                                 4         Uint4
 if (alloc[0][0]>0) {
  B-=24
 }
 if (alloc[0][0]>0) {
  B-=24
 }
 if (B>0) {
  if (buried_data_frame_key_bit==1) {
   B-=128;
  }
 B-=16
 for (b=0; b<B; b++) {
```

```
    buried_data_bits[b]                  1           BsMsbf
  }
  crc16_check                            16          Uint16
 }
}

                                         #bits       format Value
physical_data_frame() {
 B=290k
 if (physical_data_frame_key_bit==1) {
  B-=128
  physical_data_frame_key                128         Uint64
 }
 B-=16
 for (b=0; b<B; b++) {
  physical_data_bits[b]                  1           BsMsbf
 }
 crc16_check                             16          Uint16
}
```

Semantics

anchor -- Indication of the main channel containing the MPEG-2 base frame. This information is contained in the TOC. Equals %0 if the main channel is the physical channel. Equals %1 if the main channel is the buried data channel.

syncword -- The 16 bit string %1010101010010101 or $AA95.

content_descriptor -- One bit to indicate whether a second channel is used containing additional payload. Equals %0 if only one payload is used that contains an encrypted MPEG-2 base frame and an encrypted MPEG-2 extension frame. Equals %1 if the second payload contains an MPEG-2 extension frame. In that case, the first payload contains the corresponding MPEG-2 base frame.

reserved -- Reserved bits for possible future usage. The default value for these bits equals %0. For buried_data_header two bits are reserved. For physical_header one bit is reserved.

track_nbr -- This is a 7 bit integer identifying the track number to which the buried_data_frame belongs.

buried_data_frame_key_bit -- One bit to indicate if the buried_data_bits are encrypted with the buried_data_frame_key. Equals %0 if the buried_data_bits are encrypted by the track_key. Equals %1 if the buried_data_bits are encrypted by the buried_data_frame_key.

physical_data_frame_key_bit -- One bit to indicate if the physical_data_bits are encrypted with the physical_data_frame_key. Equals %0 if the physical_data_bits are encrypted by the track_key. Equals %1 if the physical_data_bits are encrypted by the physical_data_frame_key.

buried_data_frame_key -- Sixteen bytes containing the cryptographic key used to encrypt buried_data_bits.

physical_data_frame_key -- Sixteen bytes containing the cryptographic key used to encrypt physical_data_bits.

alloc[ch][sub_frame] -- Indicates the number of bits used to code the samples in channel "ch" of sub-frame "sub_frame". The three bits constitute an unsigned integer with values 0…7. The value ch==0 denotes the left channel and the value ch==1 denotes the right channel. The value sub_frame can have the values 0..2, where sub_frame==0 denotes the first subframe, sub_frame==1 the middle subframe and sub_frame==2 the last subframe.

crc4_check -- A 4 bit cyclic redundancy check word on the data starting with the first bit after sync_word up to crc4_check.

buried_data_bits[b] – Payload of the buried data channel. The number of buried_data_bits per buried_data_frame ranges from 0 to 16,064 bits.

crc16_check -- A 16 bit cyclic redundancy check word on the data starting with the first bit after sync_word up to crc16_check. The crc16_check word is present if there is a payload present. If there is no payload, no crc16_check word is present.

Decoding processes

The decoding process consists of two steps. In the first step the payload from either the buried data channel, the physical channel or both channels is decoded. In the second step the payload is converted into a complete encrypted MPEG-2 audio bit-stream.

There following options of embedding the payload into the CD format are available.

Buried data channel

No use is made of a physical channel. All header information for extracting the buried data payload, such as synchronization and allocation information, is merged with the buried data. The payload represents an MPEG-2 base and extension frame.

Buried data channel and physical channel

The header information is contained in the physical channel. This information is merged with the payload in the physical channel. The payload in the physical channel represents an MPEG-2 base frame. The buried data payload represents an MPEG-2 extension frame.

Physical channel

The control information is contained in the physical channel. This information is merged with the payload in the physical channel. The payload represents an MPEG-2 base and extension frame.

In the next sections the decoding of the payload for each of these options is described.

Extraction of buried data payload (including header information)

For the extraction of the buried data payload, the 16 bit PCM stereo samples contained in the CD-DA PCM data need to be available. Alternating a 16 bit PCM sample of the left channel and a 16 bits PCM sample of the right channel becomes available.

The decoding process describes the extraction of the buried data payload contained in uniquely decode-able buried data frames of 1152 stereo PCM samples. A buried data frame is subdivided into three buried data subframes of 384 samples each. Each subframe for each channel has an individual allocation which is denoted by alloc[ch][sub_frame]. For the corresponding channel "ch" and subframe "sub_frame", this allocation indicates the

number of LSB's of the PCM sample that is used to carry the buried data frame. The header information is always contained in the LSB of the PCM samples. The applied frame structure is depicted in figure 1. In this example the allocation of the buried data subframes is as given in table 1.

alloc[ch][subframe]	ch	
subframe	0	1
0	0	2
1	1	2
2	2	3

Table 1: **subframe allocation.**

In order to extract the correct number of LSB's that are used to hold the buried data payload, the header needs to be read and interpreted first. Dependent on the allocation information in the header, the remaining LSB's of the PCM samples that contain the header, may hold buried data payload.

For perceptual control of the header information and the buried data payload, all the LSB's contained in buried_data_frame, except for the syncword, have to pass bit by bit through a de-randomization circuit prior to interpretation. The de-randomization circuit is illustrated in figure 2. The following polynomial is applied

$s_n = t_n \oplus t_{n-1} \oplus t_{n-3} \oplus t_{n-14} \oplus t_{n-16}.$

At the start of every frame all the states T_i are initialized to the value %1.

Figure 2 shows the de-randomization circuit. The blocks T represent shift registers. The additions represent "exclusive or gates". At the start of every frame the shift registers are initialized to the value %1. For every new inserted input bit t_n, a new output bit s_n is generated.

The bits have to be inserted into the de-randomization circuit in a specific order which is explained in figure 3.

Figure 3 showstThe bits in the buried_data_frame need to be inserted into the de-randomization circuit in a specific order. In the figure this is explained by means of a

simplified header and buried data payload. Assume that the syncword is only two 2 bits and the remaining header is 6 bits. As illustrated in the figure, the allocation for the first subframe is 3 LSBs for the left channel and 2 bits for the right channel. The synchronization bits labeled "1" and "2" are read first and do not pass through the randomization circuit. The remaining bits are read in the indicated order. This order is "header first" where alternating the left and right channel is read. After that, the bits are read MSB first. All the bits labeled "3..." have to pass through the randomization circuit prior to interpretation.

Synchronization

The first action is synchronization of the decoder to the CD-DA PCM samples. The syncword is contained in the LSB of the PCM samples representing the left and the right channels. The distance between two consecutive syncwords amounts 2*1152 mono PCM samples or 1152 stereo PCM samples. In order to retrieve the syncword, a bit-stream is generated by successively concatenating the LSB of the PCM sample corresponding to the left channel and the LSB of the PCM sample corresponding to the right channel. The last 16 bits of this bitstream are continuously compared to the syncword. If there is a match for all 16 bits, only then synchronization is achieved.

Allocation

The information represented by alloc describes for each subframe the number of LSB's per channel that contain buried data payload. Header information is only present in the LSB of the first 24(+64 in the case if buried_data_frame_key_bit==1) PCM samples per channel residing in the first subframe. In the case alloc[0||1][0] is larger than %0, the LSB's up to alloc[0||1][0], except the LSB that hold the header information, contain buried data payload.

Retrieval of buried data payload

For all subframes, a number of LSB's as described in the allocation, is extracted from the CD-DA PCM data in the MSB first order and stored in buried_data_bits. For the first subframe, the bits contained in the header which is residing in the LSB of the PCM samples is omitted. The total number of bits B in buried_data_bits is given by

B0 = alloc[0][0]+alloc[1][0]

B1 = alloc[0][1]+alloc[1][1]+ alloc[0][2]+alloc[1][2]

$B = (B0+B1)*384 - (alloc[0][0]>0)*24(+64) - (alloc[1][0]>0)*24(+64) - ((B0+B1)>0)*16$

Dependent on the allocation in the subframes, the value of B is corrected for the header bits residing in the first subframe the CRC-16 bits residing in the last subframe.

CRC check

Two CRC checks are performed. The error detection methods used are "CRC-4" and "CRC-16" which generator polynomials are

$$G(X) = X^4 + X^1 + 1 \qquad \text{(CRC-4)}$$

$$G(X) = X^{16} + X^{15} + X^2 + 1 \qquad \text{(CRC-16)}$$

The bits included in the CRC_4 check are the first bit after sync_word up to crc4_check. The bits included in the CRC_16 check are the first bit after sync_word up to crc16_check. The CRC method is depicted in the CRC-check diagram given in figure 4. For CRC-4, the initial state of the shift register is $F. For CRC-16, the initial state of the shift register is $FFFF. All bits included in the CRC check are input to the circuit shown in the figure. After each bit is input, the shift register is shifted by one bit. After the last shift operation, the outputs bn…b0 constitute a word to be compared with the CRC-check word in the stream. If the words are not identical, a transmission error has occurred in the field on which CRC-4 has been applied. To avoid annoying distortions, application of a concealment technique, such as muting of the actual frame or repetition of the previous frame is recommended.

Figure 4 shows a CRC-check diagram. The addition blocks represent "exclusive or" gates.

Extraction of data fom the physical channel

In the case a physical LML channel is present, it always contains the header. Dependent of whether a second channel is used, as signaled by the content_descriptor, the LML channel will contain either the MPEG-2 base frame alone or additionally the MPEG-2 extension frame. If a buried data channel is used, the start of this frame will be synchronized with the extracted payload from the LML channel.

Synchronization

Also in the case where a physical channel is used, either in combination with a buried data channel or by itsself, the framing structure of the MPEG-2 payload remains based on frames of 1152 PCM stereo samples. A frame of 1152 PCM audio samples corresponds to 192-F3 frames. An F3-frame consists of 24 (user) bytes. During disc formatting, the starts of the frames of 1152 stereo PCM samples have been alligned with the F3-frames such that, after incorporation of the decoding delay of the LML data as a result of error correction, the data from the two channels is of the same frame. This is illustrated in figure 5.

Figure 5 shows a frame of 1152 stereo PCM samples corresponds to 192 F3 frames. At the moment the synchronization puls is detected at the "synchronization point", data at the "frame start point" becomes available from the physical channel. For that specific frame, PCM data starts reading at the "synchronization point".

At any synchronization point, at least 111 F3-frames need to be available in the buffer in order to have the proper amount of physical data available from that point onwards. If this is not the case, decoding can only start at the next synchronization point.

Content descriptor

The content descriptor describes the way, the encrypted MPEG2 audio data is distributed over the physical payload and the buried data payload. This information is used in the final stage where the physical payload can be combined with the buried data payload.

Retrieval of physical payload

The actual extraction of the physical payload is independent of the processing related to the buried data channel. For each frame of 1152 CD-DA PCM samples, A fixed amount of 290 kbytes of physical payload becomes available. The physical data becomes available byte for byte and is interpreted MSB first. After the header information is read, the data representing the MPEG encrypted MPEG-2 base (+extension) frame is read.

Extraction of buried data payload without control information

In the case the control information is not contained in the buried data channel, the extraction of the payload can start at the first PCM sample of the left channel. Synchronization and header information is contained in the physical channel. The "alloc" information describes the amount of embedded bits per buried data sub frame. An example is given in figure 6. In total there are B bits available.

Bi=alloc[i][0]+alloc[i][1], i=0,1,2

B = (B0+B1+B2)*384 – ((B0+B1+B2)>0)*16

The payload bits are read in the MSB first order, in a way as illustrated in figure 3. Appart from the payload data, room is reserved for a CRC-16 that operates on the full payload contained in the buried data channel. In the case the buried data payload is zero, no CRC-16 is written.

Combination of payloads

The buried data payload and additionally, if present, the physical payload within one frame of 1152 CD-DA PCM samples represent one encrypted MPEG-2 audio bitstream that contains 1152 multi-channel audio PCM samples. In the case no physical channel is used, the buried data payload represents a complete encrypted MPEG2 audio stream (base plus extension). In the case a physical channel is used, the buried data payload represents an MPEG-2 extension stream and the physical payload represents the encrypted MPEG-2 base frame stream. The number of bits contained in an encrypted MPEG2 base frame may not exceed the capacity available in the LML channel. The number of bits contained in the encrypted MPEG2 extension frame is variable and is a multiple of 8 bits. The division described above is illustrated in figure 7.

In the case a physical channel is used, the encrypted MPEG-2 base frame bits for the corresponding frame are extracted and put in front of buried_data_bits. It should be noted that a record carrier with a physical channel is known from USP 5,210,738 and USP 5,724,327 (PHN 13.992)

The complete bit-stream (base+extension) is decrypted and subsequently MPEG2 decoded, resulting in 1152 multi-channel PCM audio samples.

For the decoding of MPEG2 audio data reference is made to ISO/IEC 13818-3.

Whilst the invention is described with reference to preferred embodiments thereof, it is to be understood that these are not limitative examples. Thus various modifications may become apparent to those skilled in the art, without departing from the scope of the invention, as defined by the claims.

The word 'comprising' does not exclude the presence of other elements or steps than those listed in a claim. Any reference signs do not limit the scope of the claims. The invention can be implemented by means of both hardware and software. Several "means may be represented by the same item of hardware. Further the invention lies in each and every novel feature or combination of features.

CLAIMS:

1. Transmitter for transmitting a first and second digital information signal via a transmission medium, said first digital information signal comprising first frames having at least a first synchronization signal and a data portion stored in them, the transmitter comprising:

- input means for receiving the first and second digital information signal;
- processing means for processing the second digital information signal into subsequent second frames, said second frames comprising blocks of information of the second digital information signal;
- signal combination means for inserting a second synchronisation signal and at least the data portion of a first frame into a second frame of the second digital information signal so as to obtain a composite frame;
- output means for supplying the composite frames to an output terminal so as to obtain a composite signal to be transmitted;

characterized in that said signal combination means are adapted to strip the first synchronization signal from said first frames prior to inserting at least the data portion of the first frames into the second frames.

2. Transmitter as claimed in claim 1, characterized in that the signal combination means are adapted to insert the data portion of a first frame into a second frame of the second digital information signal by using buried data techniques.

3. Transmitter as claimed in claim 1 or 2, characterized in that a second frame represents a portion of the second digital information signal of a predefined duration and a first frame represents a portion of a third digital information signal of a substantially the same duration.

4. Transmitter as claimed in claim 3, characterized in that the first digital information signal is obtained by datacompression of the third digital information signal.

5. Transmitter as claimed in claim 4, characterized in that the first digital information signal is in the form of an MPEG encoded signal.

6. Transmitter as claimed in claim 4 or 5, charaterized in that the transmitter further comprises means for detecting the capacity available in a second frame to insert a first frame and generating a control signal for controlling the datacompression of the third digital information signal, said control signal being indicative for the capacity availabe in said second frame.

7. Transmitter as claimed in any of the preceding claims, characterized in that the second digital information signal comprises at least one PCM signal.

8. Transmitter as claimed in anyone of the preceding claims, the transmitter being in the form of an apparatus for recording the digital information signal on a record carrier.

9. Transmitter as claimed in anyone of the preceding claims, characterized in that the transmitter further comprises channel-encoding means for channel encoding the transmission signal prior to transmission.

10 Method of transmitting a first and second digital information signal via a transmission medium, said first digital information signal comprising first frames having at least a first synchronization signal and a data portion stored in them, the method comprising the steps:

- receiving the first and second digital information signal;
- processing the second digital information signal into subsequent second frames, said second frames comprising blocks of information of the second digital information signal;
- inserting a second synchronization signal and at least the data portion of a first frame into a second frame of the second digital information signal so as to obtain a composite frame;
- supplying the composite frames to an output terminal so as to obtain a composite signal to be transmitted;

characterized in that method further comprises the step stripping the first synchronization signal from said first frames prior to inserting at least the data portion of said first frames into the second frames.

11. Method as claimed in claim 10, characterized in that the at least the data portion of a first frame is inserted into a second frame of the second digital information signal by using buried data techniques.

12. Method as claimed in claim 10 or 11, characterized in that a second frame represents a portion of the second digital information signal of a predefined duration and a first frame represents a portion of a third digital information signal of a substantially the same duration.

13. Method as claimed in claim 12, characterized in that the first digital information signal is obtained by datacompression of the third digital information signal.

14. Method as claimed in claim 13, characterized in that the first digital information signal is in the form of an MPEG encoded signal.

15. Transmission medium in the form of a record carrier carrying a composite signal comprising portions of a first and a second digital information signal, said composite signal being a sequence of composite frames, a composite frame comprises a second synchronization signal and a data portion of a first frame of the first digital information signal, said first frame comprises a first synchronization signal and a data portion, said composite frame being obtained by inserting the second synchronization pattern and at least the data portion of the first digital information signal into a second frame of the second digital information signal, a second frame being obtained by processing the second digital information signal into subsequent second frames, said second frames comprising blocks of information of the second digital information signal, characterized in that prior to inserting at least the data portion of a first frame the first synchronization signal is stripped from said first frame.

16. Transmission medium as claimed in claim 15, characterized in that at least the data portion of a first frame is inserted in a second frame by using buried data techniques.

17. Transmission medium as claimed in claim 15 or 16, characterized in that a second frame represents a portion of the second digital information signal of a predined

duration and a first frame represents a portion of a third digital information signal of substantially the same duration.

18. Transmission medium as claimed in claim 17, characterized in that the first digital information signal is obtained by data compression of the third digital information signal.

19. Transmission medium as claimed in claim 15, 16, 17 or 18, wherein the record carrier is of the optical or magnetical recording type.

20. Receiver for receiving a composite signal and generating a first and a second digital information signal therefrom, the receiver comprising:

- receiving means for receiving the composite signal;
- first detection means for detecting a second synchronization signal so a to obtain a detection signal;
- retrieval means for retrieving a composite frame from the composite signal in response to said detection signal;
- first extraction means for extracting at least a data portion of a first frame of the first digital information signal from the composite frame;
- second extraction means for extracting at least a part of the second digital information signal from the composite frame so as to obtain a second frame of the second digital information signal;
- first output means for subsequently supplying the second frames to a second output terminal so as to obtain the second digital information signal;

characterized in that the receiver further comprises;

- synchronization signal generator means for generating a first synchronization signal;
- signal combination means for combining the first synchronization signal and the at least the data portion of the first digital information signal so as to obtain a first frame of the first digital information signal;
- second output means for subsequently supplying the first frames of the first digital information signal to a first output terminal so as to obtain the first digital information signal.

21. Receiver as claimed in claim 20, characterized in that a second frame represents a portion of the second digital information signal of a predefined duration and a first frame represents a portion of a third digital information signal of a substantially the same duration.

22. Receiver as claimed in claim 20 or 21, characterized in that the first digital information signal is a data compressed version of the third digital information signal.

23. Receiver as claimed in claim 20, 21 or 22, characterized in that the first digital information signal is in the form of an MPEG encoded signal.

24. Receiver as claimed in claim 20, 21, 22 or 23, characterized in that the composite signal is a PCM signal and the second digital information signal is substantially the composite signal.

25. Receiver as claimed in any one of the claims 20 to 24, which receiving device takes the form of a device for reproducing a composite signal recorded on a record carrier.

26. Receiver as claimed in any one of the claims 20 to 25, characterized in that the receiver comprises channel decoding means accommodated immediately after the recieving means.

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ABSTRACT:

A transmitter is disclosed for transmitting a first and second digital information signal. Said first digital information signal comprises first frames having at least a first synchronization signal and a data portion stored in them. The transmitter processes the second digital information signal into subsequent second frames comprising blocks of information of the second digital information signal. Composite frames have been obtained by inserting a second synchronization signal and at least the data portion of the first frames into the second frames by using buried data techniques. Prior to inserting at least the data portion of the first frame into a second frame the first synchronization signal is stripped from the first frame. The sequence of composite frames is transmitted via the transmission medium.

(Fig. 1)

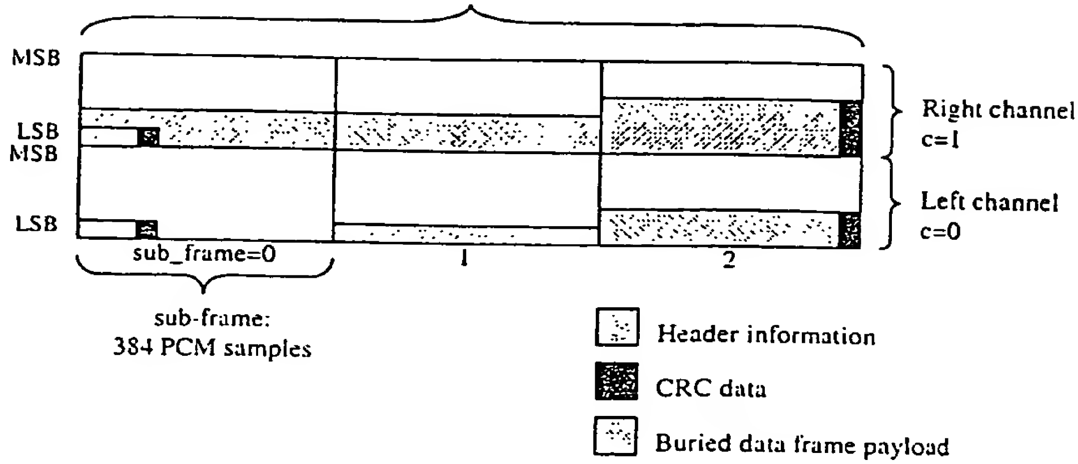
frame: 1152 PCM samples
MSB
LSB
MSB
LSB
Right channel
c=1
Left channel
c=0
sub_frame=0
1
2
sub-frame:
384 PCM samples
Header information
CRC data
Buried data frame payload

FIG. 1

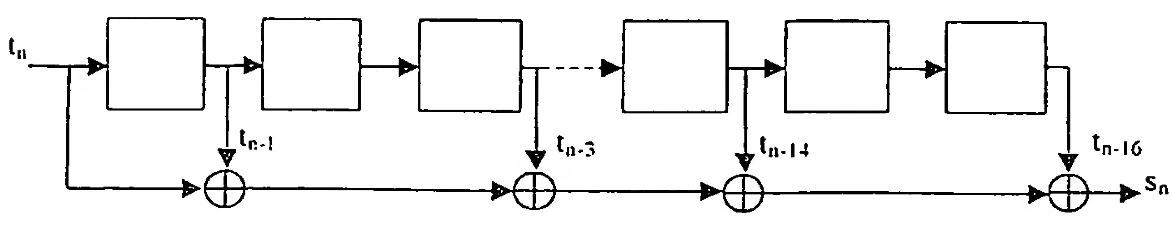
t_n
t_{n-1}
t_{n-3}
t_{n-14}
t_{n-16}
s_n

FIG. 2

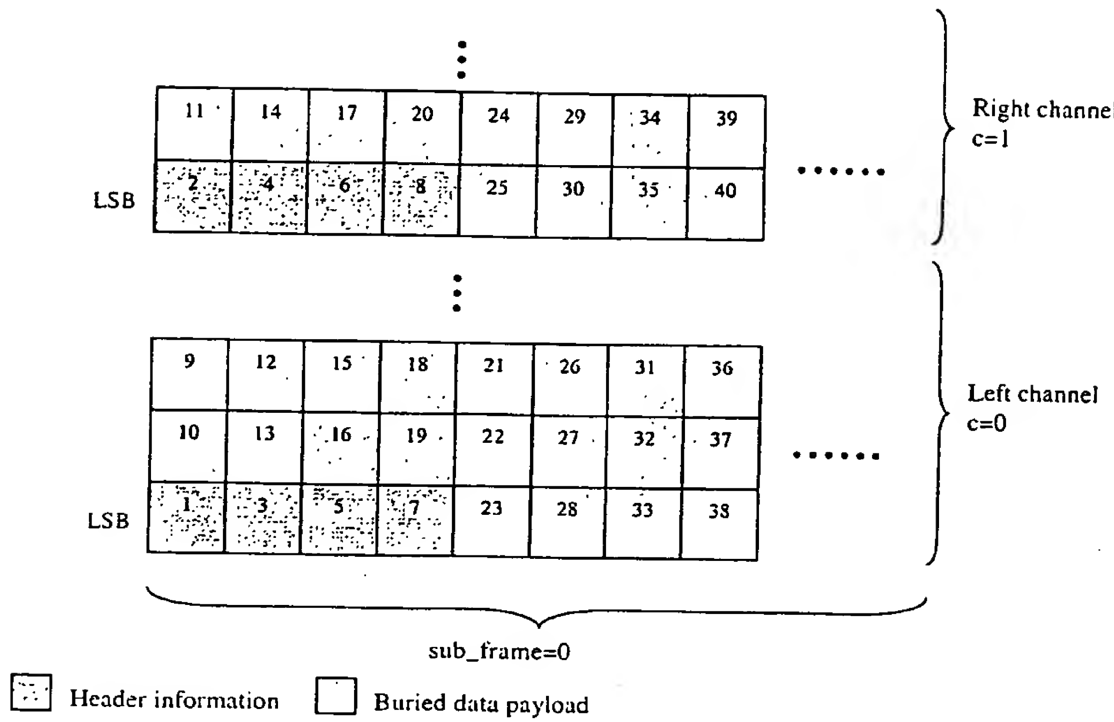
11
14
17
20
24
29
34
39
LSB
2
4
6
8
25
30
35
40
Right channel
c=1
9
12
15
18
21
26
31
36
10
13
16
19
22
27
32
37
LSB
1
3
5
7
23
28
33
38
Left channel
c=0
sub_frame=0
Header information
Buried data payload

FIG. 3

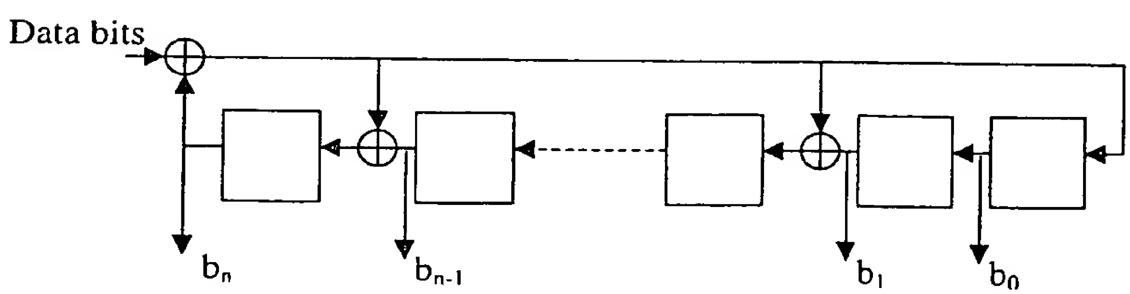
Data bits
b_n
b_{n-1}
b_1
b_0

FIG. 4

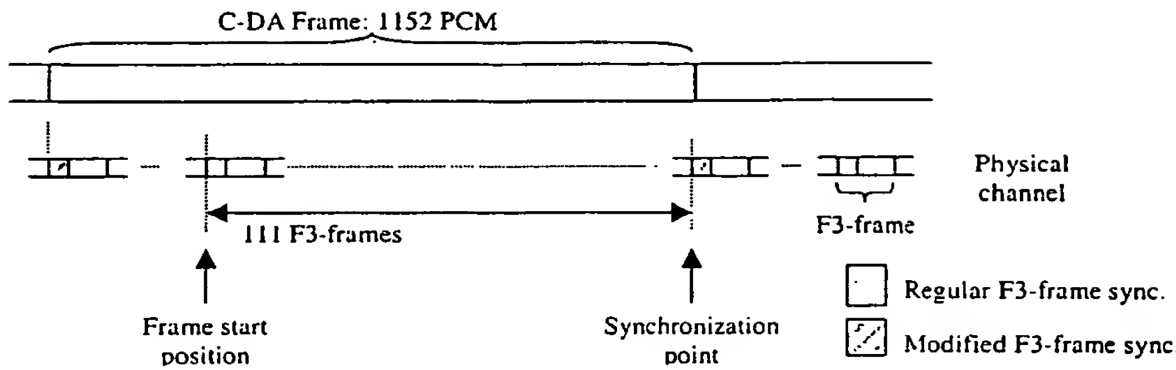
C-DA Frame: 1152 PCM
Physical channel
F3-frame
111 F3-frames
Frame start position
Synchronization point
Regular F3-frame sync.
Modified F3-frame sync.

FIG. 5

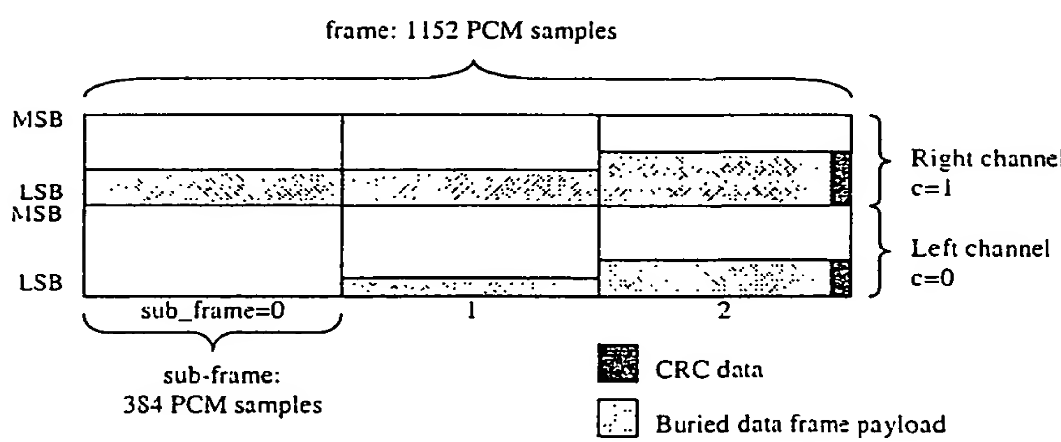
frame: 1152 PCM samples
MSB
LSB
MSB
LSB
Right channel c=1
Left channel c=0
sub_frame=0
1
2
sub-frame: 384 PCM samples
CRC data
Buried data frame payload

FIG. 6

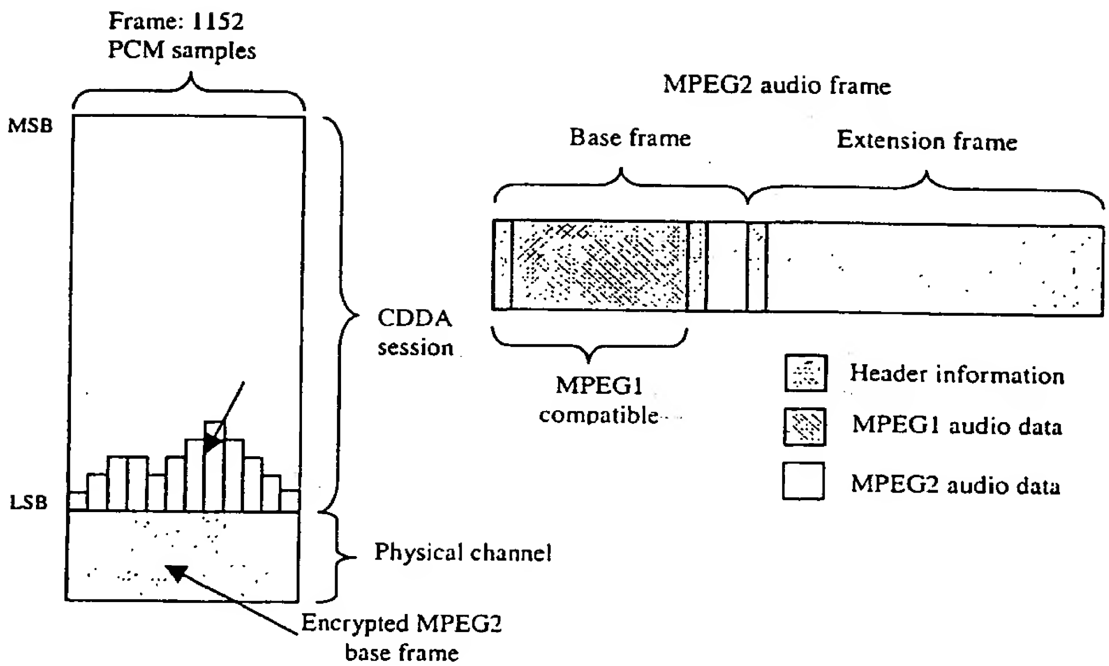
Frame: 1152
PCM samples
MSB
LSB
CDDA
session
Physical channel
Encrypted MPEG2
base frame
MPEG2 audio frame
Base frame
Extension frame
MPEG1
compatible
Header information
MPEG1 audio data
MPEG2 audio data

FIG. 7